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AUTHOR Weathersby, George B.
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ABSTRACT

This paper argues that, in addition to responding to surface manifestations of imbalance in scientific manpower supply and demand, we should examine and understand far better than we now do the nature and extent of the structural forces operative on the supply and demand of scientific talent. The author reviewed the literature and the parameters of the current situation of an apparent surplus, and admits that there is no unanimity on what remedial policies the Federal Government should follow. It is suggested that long-range national manpower planning must take a very broad view both of national economic and social objectives and of alternative productive technologies and that such planning must take into account the implications for both in terms of requisite manpower. The issue of manpower supply and demand should be viewed from the perspective of formulation of more comprehensive, even if they be crude, national objectives, and from these deduce intermediate goals. This strategy might well lead to significantly different conclusions about appropriate federal policies and programs. A 32-item bibliography is included. (Author)

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RESEARCH DIRECTORATE

Charles J. Hitch	President, University of California
Frederick E. Balderston	Professor of Business Administration Chairman, Center for Research in Management Science University of California, Berkeley Academic Assistant to the President
George B. Weathersby	Associate Director, Office of Analytical Studies University of California

OFFICE ADDRESS

2288 Fulton Street
Berkeley, California 94720
(415) 642-5490

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STRUCTURAL ISSUES IN THE SUPPLY AND DEMAND FOR SCIENTIFIC MANPOWER: IMPLICATIONS FOR NATIONAL MANPOWER POLICY

George B. Weathersby

Paper P-30

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PREFACE

This is one of a continuing series of reports of the Ford Foundation sponsored Research Program in University Administration at the University of California, Berkeley. The guiding purpose of this Program is to undertake quantitative research which will assist university administrators and other individuals seriously concerned with the management of university systems both to understand the basic functions of their complex systems and to utilize effectively the tools of modern management in the allocation of educational resources.

This paper suggests that in addition to responding to surface manifestations of imbalance in scientific manpower supply and demand, we should examine and understand far better than we now do the nature and extent of the structural forces operative on the supply and demand of scientific manpower. The current manpower policies may be inducing highly undesirable structural changes in the use of educated manpower which may have led to our current imbalances and the continuation of current policies may well exacerbate the underlying problem.

This paper was initially supported by and prepared for the Subcommittee on Professional, Scientific and Technical Manpower of the National Manpower Advisory Committee, U.S. Departments of Labor and Health, Education and Welfare. Comments by Frederick Balderston, Allan Cartter and Frank Schmidtlein were very helpful; and the assistance of Jane Bolce and Lou Pugliaresi was invaluable.

INTRODUCTION

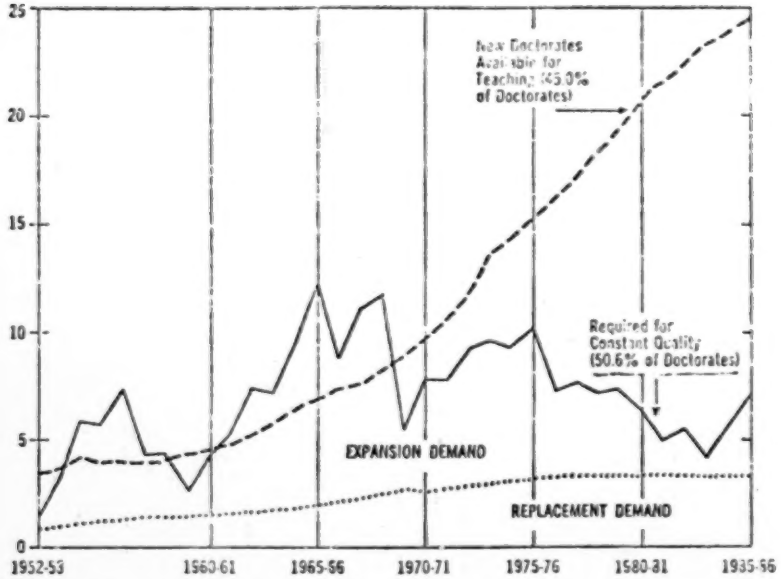
The symptoms of surplus educated manpower have intruded themselves into our national consciousness to our acute embarrassment and continuing discomfort. Not only have the priorities of federal economic and social programs been questioned and in some cases altered in response to the manpower crisis, but the basic tenets of our educational faith have also been challenged. The news media, professional organizations, academic journals, and political debate largely agree that there is a problem of imbalance in the supply and demand of educated manpower but there is no such unanimity on the problem scope, duration, or cause--nor on the remedial policies the federal government should follow. In this paper, we argue that long range national manpower planning must take a very broad view both of national economic and social objectives and of alternative productive technologies and the implications for both in terms of requisite educated manpower. To the extent that federal long term manpower policy is the concatenation of successive short term policies, we are concerned that short term reactions may deal more with symptoms than with basic causality. Finally, we observe that if we turned the issue of manpower supply and demand around and viewed it from the perspective of the accomplishment of more comprehensive national objectives, we might well be led to significantly different conclusions about appropriate federal policies and programs.

The Problems of Scientific Manpower Supply and Demand

Although the current scientific manpower "crisis" is certainly mild in comparison to the vast unemployment and economic depravation experienced in the 1930's, the last two or three years have shown for the first time in a decade increasing rates of unemployment in scientific specialities, a slowing rate of growth in starting salaries, extended periods of searching for new positions, and significant underemployment. These trends have been well documented by Wolfle and Kidd [1971]. Furthermore, the production of doctoral level professionals has been the focus of extensive investigation by several authors. Beginning in 1960 Berelson [1960] suggested that the United States might experience an increasing relative supply of Ph.D.'s by 1970. Six years later Cartter [1966a] predicted an actual surplus of Ph.D.'s exceeding academic demands in many specialities by 1970 (see Figure 1). More recently Cartter [1971] and Balderston and Radner [1971] have projected doctoral supply in excess of academic demand for two decades (see Figures 2 and 3). Brode [1971] anticipates that current patterns of attendance will produce a surplus of engineers and scientists at least until 1986 (see Figure 4).

In a recent article, Eli Ginsberg [1972] gave the following explanation for the current scientific manpower problems:

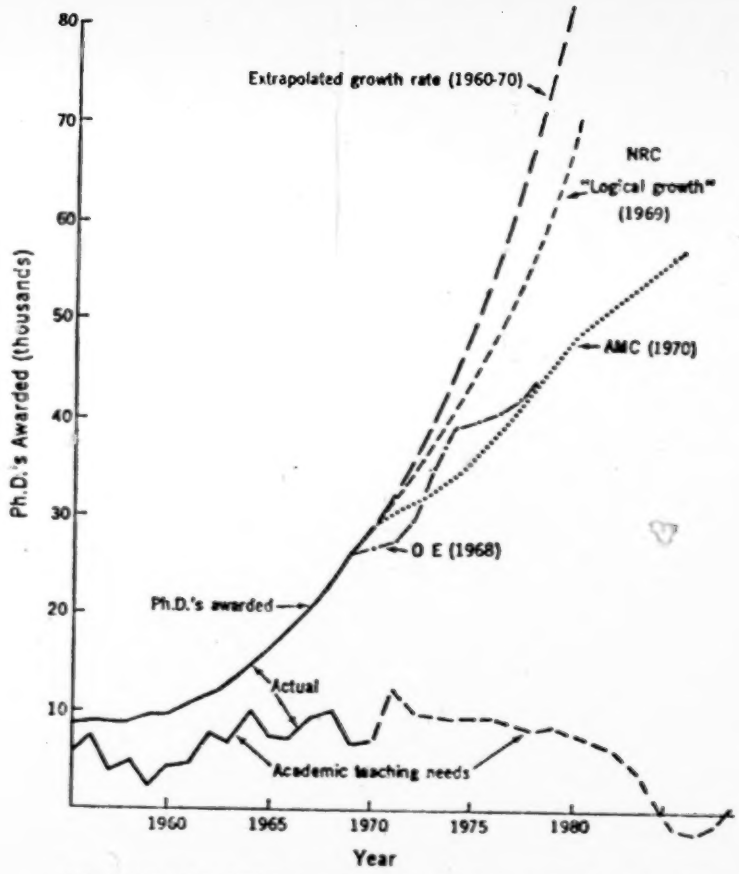
> The reasons for the present plight of professional and technical manpower may be summed up as follows: 1) a general slowdown in the economy; 2) a change-over from a defense-dependent economy to a quasi-peacetime economy, which affected primarily the aerospace industry; 3) a reduction in space expenditures; 4) the tapering off of federal support for basic research and for education, particularly at the graduate level; 5) the failure of the colleges and universities to observe the demographic trends, which signalled a reduction in the new college-age cohort and the demand for education.



New doctorates available and required to maintain constant quality of faculty in four-year colleges and universities: projections to 1985–86.

FIGURE 1

Source: Allan M. Cartter, "Future Faculty Needs and Resources," in Calvin Lee (ed.) Improving College Teaching, Washington, D.C., ACE, 1966.



Actual and projected Ph.D.'s awarded, and the number needed for college and university teaching. Included are National Research Council (NRC), Office of Education (OE), and the author's (AMC) projections.

FIGURE 2

Source: Cartter [1970]

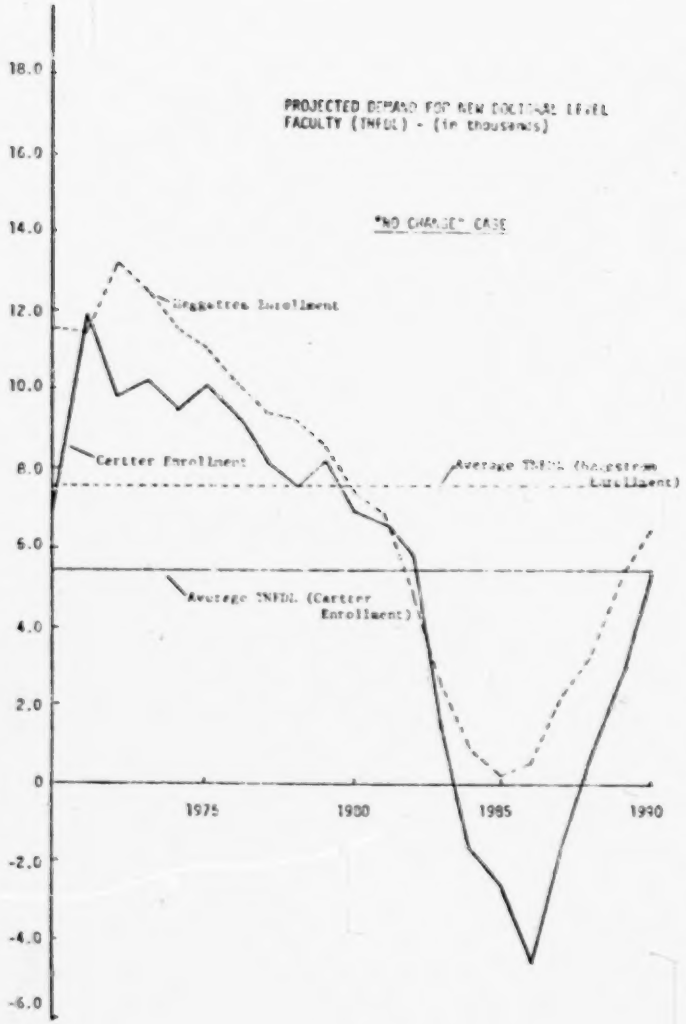
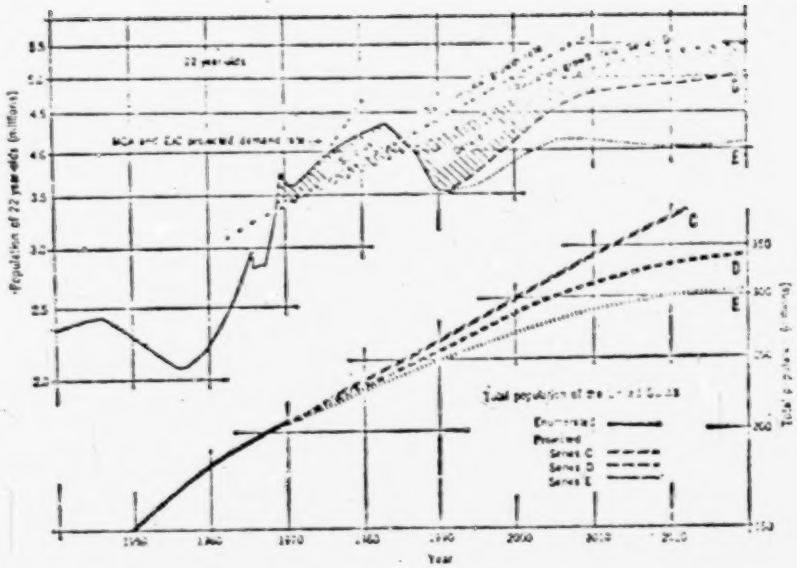


FIGURE 3

Source: Balderston and Radner [1971]



Projection of surplus and shortage of scientists and engineers from 1970 to 2025. Two separate figures are compiled here. Both are recorded on the same log scale so that the rates indicated on one may be applied to the other. The lower portion indicates the total population of the United States (*11–13*). The upper portion of the graph shows the number of 22-year-olds in any given year. The total population (Series D) from the lower portion has been drawn on the upper portion (Population growth rate–Series D), intercepting the annual population at a point (1968) where there was considered to be a balance between supply and demand in employment (Manufacturing Chemists Association, MCA; Engineers Joint Council, EJC).

FIGURE 4

Source: Brode [1971]

However, in addition to these structural economic changes and institutional planning failures are more fundamental issues of national policy and attitude.

In general, we identify some aspect of our economic or social environment as a "problem" when there is an apparent divergence between our expectations and our assessment of the fulfillment of these expectations. Particularly in the sphere of educated manpower, expectations have played a very major role both in our planning and in the current manpower crisis. These expectations have involved the educational process (universal higher education to the full extent of every person's ability), social and occupational mobility (if ethnic minority individuals could only achieve adequate educational levels, they, too, would share in the "good life" of America), and the constancy of the occupational roles of professional manpower (an increased population needs more physicians, increased research and development expenditures means proportionately more professional staff). Unfortunately, these expectations are coming unstuck--more education does not necessarily lead to better jobs; minority students are finding that just as they are starting to attend higher education in significant proportions the provision of universal education is being questioned on economic grounds and the bottom has fallen out of the job market; highly trained engineers and scientists feel betrayed by the same federal science policy that encouraged or enabled them to receive their training. What has gone wrong? More importantly, how should we think about federal manpower policies to bring the country out of its manpower crisis?

Although there has been a great deal written and discussed about federal manpower objectives and policies, these objectives are rarely the ultimate ends desired from public action but are far more often intermediate or derived objectives. Producing 29,000 Ph.D.'s a year is hardly

a meaningful objective by itself. Even the balancing of manpower supply and demand is not an overriding public objective; in some fields (e.g., teachers for elementary education) our current stock of certified individuals exceeds the demand by a factor of two or more and we are still training additional people. (Some might wonder why, however.)

In taking a broad view of manpower planning, we identify essentially three issues:

1. What criteria should be used to evaluate the national condition of scientific manpower and to evaluate alternative federal policies which seek to alter this condition?
2. What should the federal role be in manpower related policies under current structures of resource use or patterns of employment?
3. What should the federal role be in manpower related policies related to changing current resource utilization structures or employment patterns?

Each of these issues will be explored in greater detail in the following sections.

Although the problems of manpower planning seem more acute today than in the recent past, they are certainly not new, nor is their careful investigation and study a new enterprise. Eighteen years ago Kenneth Boulding [1954] began his address to a conference at Columbia University on the Utilization of Scientific and Professional Manpower with the following comments:

> Let me begin by saying that I find the whole manpower concept repulsive, disgusting, dangerous, fascistic, communistic, incompatible with the ideals of liberal democracy, and unsuitable company for the minds of the young ... The manpower concept is basically, I suspect, an engineering concept, and one of the main problems of society is to keep engineers in a subordinate position.

While there was undoubtedly some added enthusiasm in his comments, it is important to keep in mind the social, political, and psychological impacts of planning itself and to return periodically to examine our economic planning efforts from these other perspectives.

EVALUATIVE CRITERIA FOR SCIENTIFIC MANPOWER SUPPLY AND DEMAND

In the decade of the 1960's, our national expectations for the employment of scientific manpower were continuously expanding. Launched by Sputnik, fueled by the rapid expansion in postsecondary educational institutions, the professional and scientific sectors of our economy were at full employment for nearly a decade. Now the United States is experiencing some diversion from past expectations. Not only are we becoming alarmed by the employment statistics and prospects, but we are also beginning to question our expectations: What kinds of employment patterns should individuals expect? Whose expectations should be satisfied--students', governments', institutions', industries'? Although the notions of societal goals, social indicators, or gross social product [Bauer (1968)] are all very murky and nonoperative concepts, we can begin to sort out some of the criteria for national manpower planning.

Manpower goals are usually intermediate or derived goals: improved health care requires more health practitioners; solving ecological problems requires more appropriately trained individuals. From a national perspective skilled manpower is a means not an end and it is unusual in planning to devote so much attention to an intermediate goal or product. However, scientific manpower is a rather special case for several reasons: (1) There are over 2,500 accredited institutions enrolling more than 8,000,000 students at an annual cost of approximately $30 billion and these institutions consider education, training and certification to be their primary objectives. Many of these institutions are prestigious, politically powerful and demanding of support and planning in their own right, not merely as producers of intermediate goods for the society. (2) The federal government

has had considerable difficulty in providing effective signals to educational institutions. After stimulating a vast expansion in the training of scientific manpower and experiencing the difficulties of excess supply, we have learned the retrenchment is far more traumatic and difficult. One reaction to the insensitivity and ineffectiveness of national signals in many important areas is the adoption of more explicit national manpower plans and more centralized state and national planning processes. (3) Finally, the rapidly rising costs of postsecondary education have exacerbated the separation of those who pay (state or federal governments) from those who benefit (students, institutions, and employers) and the increasing conflicts of interest are being mediated by increased, explicit planning at the state and national levels.

In an ideal planning environment, planning and evaluative criteria would be expressed in terms of final goals but for many pragmatic reasons we must include proxies in national manpower planning for many intermediate goals. The social objectives of the United States include more than the number, skills and certification of scientific manpower; we are also concerned with equality of opportunity as described by individual access to education, employment, housing, and so forth, and with the social roles of women, the aged, poor and minorities. Furthermore, national economic objectives include more than the number of employees or the size of the labor force; we are also concerned with unemployment, economic growth, price stability, balance of payments, balanced sectorial development, interest rates, the money supply, and many other factors.

These observations show that the criteria for final national objectives are very broad, multidimensional, and, therefore, difficult to specify and to apply. Consequently, it is necessary for national manpower planning

to suboptimize. This process of suboptimization raises two important questions: How should national planners draw the boundary around the most important aspects of manpower planning (physician supply at the state versus national levels, role of women as economic agents versus cultural role in noneconomic organizations versus complete equality, the automobile industry versus the transportation industry)? and Given a chosen suboptimization, how should the federal government determine its priorities (academic high achievers versus social equality, environment versus economy)?

Without some criteria for evaluating the suboptimal view of national manpower planning, there is no systematic basis either for indicating the relative severity of the problem (excess scientists versus shortage of agriculturists) or for evaluating alternative federal manpower policies (training support for engineers versus humanists). Additional basic research needs to be done to identify useful, operational criteria which recognize and reconcile the many conflicting facets of manpower planning. Undoubtedly, this will be an iterative, evolving process.

FEDERAL MANPOWER PLANNING ROLE WITHIN CURRENT STRUCTURES OF RESOURCE USE

In the short run the institutions and dominant resource use patterns of our economy are relatively fixed. Consequently, realistic national manpower planning must first understand the federal role in the current patterns of production and employment of scientific manpower and then investigate the effective points of federal intervention both in the current utilization patterns and in the evolution of new production and employment patterns. This section addresses the first point while the next section examines the issues of structural change in scientific manpower training and use.

Basically, the federal government, and to a lesser extent state governments, affects the supply of and demand for scientific manpower through the dissemination of information, resource support, and direct governmental action. We shall discuss these in turn.

Information Dissemination

At the basic counting level the federal government has traditionally supplied extensive data relevant to manpower planning including the decennial census, labor force, employment, salaries, and college enrollments. Numerous federal agencies collect these statistics in extensive detail and on a regular basis and they form the factual background against which alternative national manpower policies must be viewed. One example of the impact of such data is the demographic projections for college enrollments which, while increasing, fueled the expansion of graduate and

professional programs and now, with the anticipated levelling off and possible absolute decline of college enrollments, these projections are having a profound adverse affect on the resource support and planned expansion of educational institutions.

Another category of information that is very relevant to national manpower planning is the qualitative ratings of employment opportunities. The American Council on Education ratings of graduate educational institutions [Cartter (1966), Roose and Andersen (1970)] and the earlier Brown ratings [Brown (1965)] provided some index of the quality of graduate departments not only for prospective students but also for prospective faculty members. Much more qualitative information about potential employment opportunities is needed and would be extremely useful to students making career choices and fundors making resource commitments.

In addition to general, national data, institutionally specific signals could significantly increase the coordination of the national manpower market. Particularly in manpower production we are caught in the classic dilemma between individual logic and collective logic [Olsen (1965)]: as long as anyone is hiring new Ph.D.'s, everyone seeks to expand their share of the demand by expanding their production. Consequently, dozens of new doctoral programs begin each year even in rapidly deteriorating markets. As a countertrend, some prestigious schools are currently reducing their doctoral enrollments because: (a) the financial crisis is increasing [Balderston (1972), Cheit (1971)]; (b) prestige is primarily associated with faculty and graduates not enrollment [Cartter (1966b), Roose and Andersen (1970)]; and (c) there is only a weak relationship between enrollment and degrees awarded [Breneman (1970)]. These issues impact both federal support of postsecondary education and manpower planning at the

local and national levels as institutional managers seek to relate national trends to local decisions.

Resource Support

As we have all witnessed during the past decade, the institutions of our society (including educational institutions) are very responsive to money. In the scientific manpower arena, the federal government's resource support policies have played a central role in both the demand for and supply of educated manpower. The issues of the nature and extent of federal resource support for scientific manpower are vitally important because the objectives of employing firms and agencies differ significantly from the objectives of supplying institutions, and all of these probably differ from the objectives of "the public." Meanwhile, the achievement of national manpower objectives must somehow sort out and align these basically inconsistent postures.

In response to these issues, the federal government has provided resource support through: (a) direct aid to students (NDEA, EOP, EOG) and to educational institutions (HEFA, Developing Institutions Program, Capitation Grants); (b) basic program support of R&D firms, nonprofit organizations (RAND, NIH, NSF, Urban Institute), and support of basic and applied research in colleges and universities which are major employers of scientific manpower; and (c) various tax incentives available to nonprofit and educational institutions and deductability of certain personal educational expenses. The various federal manpower support programs have generally responded either to critical national needs, e.g., the massive postsputnik scientific expansion, or to special interest groups, e.g., professions, emerging colleges, and scientific firms, rather than responding to well articulated and integrated national goals.

Direct Federal Action

A final federal role of manpower planning within the current social and economic institutions is that of direct action both in terms of federal legislation and of federal employment. Congress has had great impact on the national manpower arena through legislation prohibiting discrimination on the basis of sex, race, religion, national origin or age. Through the National Labor Relations Act Congress has established the procedures for collective bargaining which now encompass over 10% of college and university faculties. Federal legislation also increases the importance of accreditation and certification by restricting federal support to institutions or individuals with prior professional approval.

We should not forget that the federal government is the largest employer in the United States and as the largest employer has enormous direct and indirect impact on the issues of wages, performance evaluation versus formal certification, retraining versus new hires, and the whole and essential process of internal manpower planning. We will discuss these issues of federal intervention and direct action in more detail in the next section.

FEDERAL ROLE IN CHANGING THE PATTERNS OF USE OF SCIENTIFIC MANPOWER

As a general conceptual approach to federal manpower planning, we believe one should: (a) derive specific manpower objectives or targets from more general economic and social goals, (b) generate and examine alternative mixes of human and physical resources for achieving these objectives, (c) evaluate the direct and indirect effects of each alternative according to criteria consistent with national objectives, and (d) recommend a most preferred course of action as the national manpower plan. While this approach is certainly not new to the field of public planning, certain steps have been notably absent in past professional, scientific and technical manpower studies, reflecting the assumption that technological patterns and organizational constraints are fixed (even in the long run). Only in the broader context of social and economic objectives can one formulate meaningful national policies for graduate education, alternative certification or accreditation procedures, or the government's own role as an employer.

Thinking About Federal Objectives

Over the last few years numerous commissions, committees, study groups, task forces and other efforts have grappled with descriptions of broad federal objectives. While none of these efforts seem to have been overly successful, the formalism of program budgeting and the continuing debate on national priorities have reiterated the rhetoric [Balderston and Weathersby (1972a, b)]. The federal budget is couched in terms of

Human Development, Social and Physical Development, Society Under Law, International Affairs, and Other (see Table 1). These categories all sound like good things--we should want more human, social and physical development, a better society under law and improved international relations--but these concepts are not operational at all.

The Administration, the Congress and numerous groups have espoused somewhat more meaningful objectives, such as:

- achieve full employment with a high level of economic growth and reasonable price stability;
- provide all citizens with an equal opportunity to participate in American society and in the shaping of governmental decisions affecting their lives;
- guarantee that no American will go without the basic necessities--food, shelter, health care, a healthy environment, personal safety, and an adequate income;
- assure adequate national security against military threats from abroad;
- meet our obligations to assist in the economic development of the world's less-developed nations.

In terms of manpower planning, these objectives translate into both direct manpower objectives (e.g., full employment) and indirect manpower objectives (e.g., to provide a mix of health professionals to meet our health care objectives). Since the time of the New Deal, federal policy has promoted full employment as a social and economic objective. This objective has resulted in a series of federal programs designed to influence employment patterns to encourage full employment, and in the middle 1960's these programs were very successful at stimulating demand. The importance of this single objective cannot be understated both because it leads to a strong negative connotation of excess supply and because

TABLE 1

Federal Budget by Objectives

	Estimated 1971	Proposed 1972
	(millions of $)	
Human Development		
Employment and Manpower Training	2,806	2,968
Conversion to Peacetime Economy	178	216
Income Maintenance: Social Insurance	47,665	50,935
Income Maintenance: Income Support	11,300	13,587
Health	17,257	19,140
Education	9,351	10,075
Subtotal	88,557	96,918
Social and Physical Development		
Fiscal Relief for States & Localities	--	3,750
Metropolitan Development	2,520	3,078
Housing	1,678	1,973
Transportation	7,763	8,279
Environment & Natural Resources	3,374	4,116
Family Planning & Population Growth	87	140
Rural Development and Agriculture	5,871	6,136
Research & Development (including NASA, AEC & NSF research expenditures)	5,956	5,894
Subtotal	27,249	33,366
Society Under Law		
Law Enforcement and Criminal Justice	932	1,285
Equal Opportunity	111	130
Consumer Protection	110	128
Subtotal	1,153	1,543
International Affairs		
National Defense & Military Assistance	74,500	76,000
Foreign Economic Assistance	2,993	3,240
Subtotal	77,493	79,240
Other		
Interest	19,433	19,689
Maintenance of Mortgage Market	- 977	- 230
Postal Service	2,353	1,333
Other Government Activities	6,491	7,092
Subtotal	27,300	27,882
Less:		
Duplications	-1,800	-1,946
Employer Share, Employee Retirement	-2,486	-2,461
Interest Received by Trust Funds	-4,711	-5,310
Total	212,755	229,232

Source: Budget of the United States Government, Fiscal Year 1972, quoted in Robert S. Benson and Harold Wolman (eds.), Counterbudget, Praeger, 1971. Assembled by the National Urban Coalition.

it has established a significant precedent for federal "intervention" in state and local economic affairs. Also significant are the implications which this objective has for federal involvement in social programs designed to influence education, manpower training and occupational patterns.

Beyond the direct manpower objectives of full employment either in general or in particular economic sectors, we observe that educated individuals are generally means for achieving the other remaining public objectives. Consequently, there is a public responsibility to find more effective or more efficient means to achieve equal opportunity, provide basic necessities, acquire a high level of economic growth, and so forth. As we discuss in this section, it is this search for more productive means to desired social objectives that may well have the greatest impact on manpower planning.

The Role of Educated Manpower in the Accomplishment of Federal Objectives

The purpose of this section is not to discuss the educated manpower requirements induced by the various federal objectives and their priorities; indeed, the technical issues of manpower requirements projection have been the subject of a great deal of study elsewhere. On the other hand, the structural role of educated manpower in the accomplishment of public objectives has received somewhat less attention and, at least in the manpower requirements forecasting techniques, is usually taken for granted. Any long term view of federal planning should consider alternative delivery systems and production processes including the different roles for educated manpower because the federal government can affect not only the levels of educated manpower but also the process of their preparation and utilization. We discuss these concepts in terms of three sectors:

(a) economic, scientific and educational; (b) social, and (c) new roles of the federal government as an employer.

Economic, Scientific and Educational Sectors

In manpower planning we recognize that economic and scientific enterprises need skilled manpower for their operation. Furthermore, there is the implicit assumption that without public intervention in the production of many types of educated manpower, the supply will be inadequate. However, there are a number of issues in this seemingly direct line of causality. While it is true that skilled manpower is required in the economic and scientific sectors, it is not clear what field and skill level mix is more effective. In looking at the composition of the national economy of six Western European nations, the OECD Mediterranean study found that the proportion of people by skill level active in each sector of the economy differed significantly between countries by as much as a factor of ten. A similar study for Greece is shown in Table 2. Although the economy of Greece is vastly different from the economy of the United States, the Greek economy is roughly comparable to the economies of Yugoslavia, Portugal, Italy and Spain; therefore, Table 2 represents a meaningful comparison. Notice particularly that the percent of high level technicians varies from 0.78 to 8.63, which is a factor of 11.

This variation in labor input coefficients is often listed as a major problem in manpower requirements forecasting. However, the other side of this coin is that there may be some other mix of skills that is either more efficient or more effective (or possibly both) in achieving national objectives. This concept is behind much of the discussion of para-medical, para-legal and other para-professional training and staffing proposals.

TABLE 2

Labor Skill Distributions for Greece

	Actual		1961 Requirements*			
Skill Level	1954	1961	Yugoslavia	Portugal	Italy	Spain
Professional and Managerial	2.12	2.57	5.12	1.51	2.50	4.10
High Level Technicians	2.74	3.31	6.26	4.65	8.63	0.78
Skilled and Semi-Skilled	38.73	40.43	43.44	29.28	18.44	42.19
Unskilled	56.41	53.69	45.18	64.56	70.43	52.93
Total	100.00					

*Requirements based on sectoral labor input coefficients of each of these countries applied to the sector outputs for Greece in 1961.

Source: George Psacharopoulos, "An Economic Analysis of Labor Skill Requirements in Greece 1954-1965," unpublished Dissertation, University of Chicago, 1968, pp. 73; 80, quoted in Samuel Bowles, Planning Educational Systems for Economic Growth, Harvard, 1969.

Although firms and institutions have initiated some substitution of various skilled labor, such as substituting teaching assistants for faculty in universities and paramedics for physicians for some clinical care, there is ample reason to believe that there will be significant barriers to extensive labor-labor substitution in the future unless there is governmental intervention. Part of the problem is certification for non-traditional skills for which there is little incentive for institutions to lend their expertise and prestige. This is one of the reasons Frank Newman [1971] and others have recommended federal or regional certification boards, particularly for new areas of para-professional competence. Part of the problem is the attempt by some professional organizations to control the supply of their specialty through restrictive entry. This is a very sensitive area in which federal policy makers will have to tread lightly but changes in labor-labor substitutability could significantly alter both the future demand for and effectiveness of skilled manpower.

As a brief example of the possible effects of improved labor-labor substitution, Carl M. Stevens [1970], a professor of economics at Reed College, has studied the supply and demand of physician services in Oregon and concluded that if the Kaiser Permanente group practice approach with its extensive use of para-professionals were adopted for most of the national population, then one-eighth to one-third of the non-federal physicians providing patient care would be "surplus" and, presumably, the popular press would lament the plights of unemployed physicians. It's true that group practices impose some psychological or financial costs on physicians or they would be more widely employed. But producing the additional 28,000 to 83,000 physicians estimated by Stevens as needed to support the traditional GP technology imposes high costs on taxpayers and

on patients. The governments (state and federal) must weigh these costs in determining public support for health care systems. The point of this discussion, however, is that the public decision should not be constrained by the current GP technology and that we should seriously investigate the public costs and benefits of group practice, para-professionals or whatever.

In addition to labor-labor substitutability is the familiar labor-capital substitutability. While this trade-off is very familiar in basic production, transportation and communication industries, it is also relevant to professional, scientific and technical fields. Engineers can now use computers to aid in design and calculation, thereby replacing some draftsmen and other specialists. Certain types of medical diagnosis have been automated with the potential of significantly increasing the productivity of medical staffs. Computer aided instruction, if available on a large scale, has been shown to be more cost-effective for classroom instruction in some fields. The list is ever growing and the importance of the discussion is that federal manpower policies that emphasize or encourage the labor side of possible labor-capital substitution may well encourage both unnecessarily high demand for educated manpower and inefficient total resource utilization. Although unnecessarily high demand for skilled manpower may be consistent with objectives of full employment, its price is the unnecessary additional productive resources consumed and, once again, federal policy makers must balance the total costs and benefits of possible labor-capital substitution.

Another facet of these substitutability considerations is that public manpower policy has focused primarily on affecting the supply of educated manpower in critical fields. Consequently, by subsidizing colleges and universities and by supporting students, the federal government has

increased both the quantity and quality of educated manpower at no additional direct cost to the employing firm or agency. The increased manpower quality would logically increase the demand for manpower vis-a-vis other input factors, especially since the increasing manpower supply would slow the rate of price (salary) increases. Also, the increasing quality of undergraduate education has narrowed the qualitative differences between bachelors, masters and doctoral level students and many firms are preferring to hire the lower certification level because of the relative price advantage. (The Engineering Manpower Commission of the Engineers' Joint Council [1970] reported that the percent of Ph.D.'s in engineering with no offers or plans of employment was twice the corresponding percent of bachelor's degree engineering graduates.)

This brings us around to educational institutions themselves which are both major consumers as well as major producers of educated manpower. In the past decade, Folger [1970] has estimated that about 60% of all doctorates are employed in higher education and about 50% of all master's degree recipients are employed in all levels of education. In other words, higher education system's absorption of its own production has been very heavy when attempting to increase the annual flow of graduates.

The doubling of higher education undergraduate enrollments in the 1960's required more teachers which in turn required more graduate students who required more teachers, etc. Assuming a constant educational technology (which seems all too safe an assumption), one can calculate how many total faculty and new faculty will be needed to teach the anticipated student enrollment for the 1970's and 1980's. In their valuable works, Cartter [1971] and Balderston and Radner [1971] have performed such calculations under the assumption of constant technology with variable student/faculty ratios. However, the issue for intermediate to long-range manpower

planning is not only the new faculty demand given the current technology but what other possible educational technologies would be either more effective or more efficient?

June O'Neill [1971] has recently completed a report for the Carnegie Commission in which she estimates that there have been no productivity gains in higher education since 1930 (using dollars/weighted student credit hour as a productivity measure). Nevertheless, there is strong evidence that the graduates of higher education have demonstrated substantial qualitative improvements over time, but it is not clear whether this should be attributed to better elementary and secondary schools, better educated parents, general cultural improvements, or the institutions of higher education themselves.

However, with so much of our society dependent upon higher education for its highly skilled manpower, the efficiency with which this manpower is produced should be (and is) a matter of great public concern. David Breneman [1970] has shown that on the Berkeley Campus the number of total student years of input per Ph.D. degree awarded varied from about 5 to almost 20 for the 28 ACE ranked departments. Another study [Office of Analytical Studies (1968)] showed that when doctoral student attrition is properly included, a Ph.D. in English costs almost twice as much as a Ph.D. in engineering at Berkeley.

In their analysis of higher education, the Carnegie Commission staff [1971] recommended moving towards a three-year baccalaureate and four-year doctoral program. The Ford Foundation's Career Fellowship Program required participating departments to accelerate the time to the Ph.D. to be eligible for continued support. The point is that some thought has been given to altering the educational technology and, given the observed

responsiveness of higher education to fiscal incentives, a well conceived and carefully structured federal program within the limits of available technology might succeed in improving the productivity of education with the impacts of lowering the social cost of education and reducing the internal demand for its own products.

Before leaving this discussion of the economic, scientific and educational sector, we should all at least be aware of the long run view of scientific and engineering manpower espoused by Wallace Brode [1971], former president of the American Association for the Advancement of Science. Based on a series of saturation assumptions, such as only 2% of the 22 year old population has the ability and motivation to be scientists and engineers, Brode estimates that about 120,000 surplus engineers and scientists will be produced between 1968 and 1986, at which time a severe shortage will begin unless we find some way to put 120,000 people in an occupational "holding pattern" for up to 19 years. Brode is arguing for a national manpower act to employ many of these surplus engineers and scientists on socially useful tasks.

Social Sector

In this section we consider some of the issues involved in the role of educated manpower in the various approaches used in the achievement of many of the frequently espoused public objectives which relate to improving the economic, physical and social well-being of our citizenry. Once again, we do not attempt to forecast manpower supply and demand; rather, we attempt to improve the structure which generates these manpower demands.

Perhaps one of the largest influences on the demand for educated manpower in the social sector is the decision to maintain a complex, hierarchical structure for the delivery of most social services. We

often have city, county, state and federal offices all attempting to coordinate and cooperate in health, welfare, counseling, retraining and other programs. This multiplicity of structures, with thousands of city and county agencies, fifty state structures, several regional and national structures, creates enormous employment demand at uncounted additional costs--but it presumably also possesses off-setting political and participative benefits. The choice of highly decentralized, hierarchical structures for the social services (unlike the highly centralized social service structures of some Western European countries) significantly increases the number of skilled people needed in these agencies and also alters the mix of skills needed.

An example of some of these observations is the general goal of equality of opportunity. Although always an implicit social goal in U.S. history, little was done on a national level to insure equality of opportunity until the 1950's when the civil rights movement began to press for court decisions to establish legal precedents in discrimination cases. This drive culminated in 1964 when the Civil Rights and the Economic Opportunity Acts were signed into law. One impact of these two acts was to accelerate growth both in the legal professions and in government programs designed to improve equality of opportunity. The specification of Title VII of the Civil Rights Act that all discrimination on the basis of race, religion, sex or national origin was illegal instigated a major growth in the legal profession to meet demands for court hearings in discrimination cases. The need for legal services in poverty areas as a step toward increasing economic opportunity was recognized in the establishment of Neighborhood and Rural Legal Assistance offices funded by the Economic Opportunity Act.

However, court decisions and legislation are not the only methods of securing equality of opportunity. The Philadelphia Plan uses contract compliance to integrate labor unions, or at least the work force for federal construction. The HEW civil right compliance investigations are "encouraging" colleges and universities to employ and compensate women faculty members more fairly. One could imagine tax incentives for firms to hire minorities and other fiscal and non-monetary incentives that might prove effective. Each of these different approaches requires a different number of individuals with different sets of skills for similar effectiveness and the choice of an enforcement procedure has definite manpower implications. Therefore, in selecting an approach or alternative for the the accomplishment of a social objective, the manpower implications should be included in the reckoning of total costs and benefits.

In addition to the importance of the political or organizational structure of the delivery of social services, there are other forces which shape both the context and the content of social programs with strong implications for manpower policies. Perhaps one of the most important of these forces for manpower planning is the secularized Protestant Ethic which still seems operative in much of Middle America. Although rarely stated as an explicit social goal, its contribution to the formulation of values and ideals is significant in that it affects the whole moral climate in which social goals are identified, enacted, and pursued. Simply stated, the basic precepts of the secularized Protestant Ethic are: (a) the necessity for individual responsibility for action and survival; (b) the secularized version of the doctrine of vocation, stating that an individual's character and worth are defined in terms of a <u>career</u> thereby making <u>work</u> necessary for moral as well as physical survival. This doctrine has

led to (c) professional success and material wealth as indicators of moral integrity.

The implications of this doctrine in the context of social objectives are far reaching indeed. An example of this issue is in the notion of serial careers. From economic and social perspectives, serial careers and mid-career retraining programs are viable mechanisms for furthering economic growth and the productive employment of our citizenry. The whole notion, however, collides with our expectation of constant success in a single vocation and the work ethic. Witness recent material found in the popular press about the psychological traumas experienced by unemployed aeronautical engineers who found it necessary to train for radically different and often lower status careers. People felt that they had failed personally, that their self identity had been irreparably damaged, and felt thrust in an abyss of despair and frustration. The implications of this single phenomenon for the structure of training programs for scientific and technical manpower are vast, and training programs which ignore the moral-psychological climate and address simply an economic or a social question are bound to fail to some extent.

Direct Federal Role as an Employer

When thinking about national manpower planning and the role of educated manpower in the accomplishment of federal objectives, it is all too easy to forget that the federal government is the largest employer in the United States and, therefore, it is in a position to actually do something rather than forever attempting to persuade and cajole others into realizing national manpower goals. The Department of Defense employs almost 5 million people including military personnel. About 20% of the

scientists and engineers in the total industrial labor force are employed in prime contractor aerospace companies. The Department of Labor estimates another 3 million members of the labor force are directly involved in military industrial work. In addition there are several million more employees in NASA, AEC, HEW, and all other federal agencies. The collective impacts of the federal government employment practices are significant and pervasive.

The government's own use of educated manpower appreciably affects the total demand for skilled manpower both directly and by example. The manner in which public agencies make their labor-labor and labor-capital substitutions will also affect their manpower requirements and there is little evidence that these choices are being made in any socially optimal way. Although the Federal Civil Service is the largest formal meritocracy, Ivar Berg [1969] and others have complained that Civil Service requirements have all too often followed the fetish of degrees even though on-the-job performance seems to bear little relationship to formal certification. And, of course, Lawrence Peter [1969] has argued the ultimate folly of strict meritocracies.

Instead of leading the rest of the nation by paradigm and example, government employment practices seem to mirror the lowest common denominator in the society. Protection <u>for</u> the employee soon becomes protection <u>of</u> the employee and federal employment soon loses its vitality. However, instead of merely indicating the overbureaucratization of federal employment, we want to stress that the federal government is in an excellent position to affect national manpower policies through its own employment policies.

CONCLUSION

There seems little argument that there is currently a surplus of scientific and professional manpower who are either underemployed or unemployed. In addition to the reasons advanced by Ginsberg [1972], some might add a changing aspiration of youth away from traditional scientific employment and towards more popular but less employable applications. If you accept this diagnosis, as many observers have, then it is tempting to prescribe turning the crank the other way. If we would just speed up the economy, possibly through tax cuts, investment credit and deficit spending, increase space expenditures by, for example, initiating a new multi-billion dollar space shuttle project, and even increase federal support for research and development and education--then our scientific manpower problems would be over and all would be well again. Or would they?

The purpose of this paper has been to suggest that in addition to responding to surface manifestations of imbalance in manpower supply and demand, we should examine and understand far better than we now do the nature and extent of the structural forces operative on the supply and demand of professional, scientific and technical manpower. The current manpower policies may well be inducing highly undesirable structural changes in the use of educated manpower which may well have led to our current imbalances and the continuation of turning the crank backwards may well exacerbate the underlying problem.

Instead of beginning with the symptoms of excess supply and asking, "What went wrong?", we think it would be very fruitful to begin by asking, "Where do we want the United States to be in five years? How would we know if we got there?" In other words, to begin with even a crude and

imprecise statement of national objectives from which we deduce objectives for intermediate goals such as manpower. Only in this way can we hold a measuring rod up against the problem and judge its actual size.

Also, instead of always dealing with marginal changes within the current technology, we should search for alternative technologies which are preferable. While there is always a quixotic, utopian tint to such suggestions, it is clear that there exist significant structural improvements, such as group medical practice, external degree certification, and computer aided instruction, which have not been widely implemented. Perhaps this is for valid and fully supportable reasons, but are we certain that for a given federal expenditure in manpower objectives we would not benefit even slightly from exploring radically different but currently available technologies?

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